

[SPECIFICATIONS]

[NAME OF INVENTION]

Dual Panel Type Organic Electroluminescent Device and Method for Fabricating the same

[BRIEF EXPLANATION OF FIGURES]

FIG. 1 is a circuit diagram of a pixel of a related art active matrix organic electroluminescent display (ELD) device;

FIG. 2 is a cross-sectional view of a related art active matrix organic electroluminescent display device;

FIG. 3 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a first embodiment of the present invention;

FIG. 4 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a second embodiment of the present invention;

FIGs. 5A and 5B are cross-sectional views of an electrical connecting pattern to explain a plastic deformation property that is required for the second embodiment of the present invention;

FIG. 6 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a third embodiment of the present invention;

FIG. 7 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a fourth embodiment of the present invention; and

FIG. 8 is a flow chart illustrating a fabrication sequence of a dual panel type organic electroluminescent display (ELD) device according to a fifth embodiment of the present invention.

FIGs. 10a to 10e are cross-sectional views taken along a line IX-IX' of FIG. 9 and illustrating fabrication process of an array substrate according to the present invention.

**\* Explanation of major parts in the figures \***

210 : first substrate	240 : array element layer
244 : electrical connecting pattern	250 : second substrate
252 : first electrode	260 : organic light emitting layer
262 : second electrode	E : organic electroluminescent diode
T : thin film transistor	

**[DETAILED DESCRIPTION OF INVENTION]**

**[OBJECT OF INVENTION]**

**[TECHNICAL FIELD OF THE INVENTION AND PRIOR ART OF THE FIELD]**

The present invention relates to an organic electroluminescent device and more particularly, to a dual panel type organic electroluminescent display device and manufacturing method for the same.

Because the organic electroluminescent display (ELD) device that is one of new flat panel displays (FPDs) voluntarily emits light, the viewing angle and the contrast ratio are superior compared to the liquid crystal display (LCD) device. In addition, because it does not need a backlight as the light source, it has advantages such as a lightweight, small dimension and low power consumption. Moreover, the organic electroluminescent display

(ELD) device can be driven with a low DC (direct current) and has a fast response time.

Because the organic electroluminescent display (ELD) device uses solid material instead of fluid material such as liquid crystal, it is more stable under external impact and has a wider range of temperature under which the organic electroluminescent display (ELD) device is operated than the liquid crystal display (LCD) device. Besides the organic electroluminescent display (ELD) device has an advantage in terms of a production cost.

Specifically, because a deposition apparatus and an encapsulation apparatus are all the apparatuses for manufacturing the organic electroluminescent display (ELD) device while the liquid crystal display (LCD) device or plasma display panels (PDPs) need many kind of apparatuses, a manufacturing process for the organic electroluminescent display (ELD) device is very simple compared to the liquid crystal display (LCD) device or the plasma display panels (PDPs).

The organic electroluminescent display (ELD) devices may be classified into a passive matrix-type and an active matrix-type.

In case of the passive matrix-type organic electroluminescent display (ELD) device, because pixels are formed in a matrix form by crossing the scan lines and the signal lines, the scan lines must be sequentially driven to drive each pixel. Accordingly, an instant luminance resulting from multiplication of an average luminance and the number of the scan lines is required to obtain a desired average luminance.

However, in case of the active matrix-type organic electroluminescent display (ELD) device, a thin film transistor, i.e., a switching element, is formed in each sub-pixel to switch the pixel on and off and a first electrode connected to the thin film transistor is turn on and off by the pixel. In addition, a second electrode functions as a common electrode.

Moreover, in case of the active matrix-type organic electroluminescent display (ELD) device, voltage that is applied to the pixel is stored to a storage capacitor  $C_{ST}$  and maintained until a signal for the next frame is applied.

Accordingly, the pixel can retain the signal until the next frame regardless of the number of the scan lines.

Because the active matrix-type organic electroluminescent display (ELD) device can obtain a same luminance with low direct current (DC), the active matrix-type organic electroluminescent display (ELD) device has advantages such as low power consumption, high resolution and a large size.

A basic structure and an operational property of the active matrix-type organic electroluminescent display (ELD) device will be described hereinafter with reference to FIG. 1.

FIG. 1 is a circuit diagram of a pixel of a related art active matrix organic electroluminescent display (ELD) device.

In FIG.1, scan line is formed in a first direction and the signal and power supply lines and are formed in a second direction perpendicular to the first direction. The signal line and the power supply line are spaced apart from each other and define a sub-pixel by crossing the scan line.

A switching thin film transistor (TFT), i.e., an addressing element, is formed at a position near an intersection of the scan and signal lines. A storage capacitor ( $C_{ST}$ ) is electrically connected to the switching thin film transistor and the power supply line. A driving thin film transistor (TFT), i.e., a current source element, is electrically connected to the storage capacitor ( $C_{ST}$ ) and the power supply line and an organic electroluminescent diode is electrically connected to the driving thin film transistor.

If current is applied to organic light emitting material of the organic electroluminescent display (ELD) device in a positive direction, electrons and holes make a recombination by passing through a P-N junction between anode electrode for providing holes and cathode electrode for providing electrons. The combined electron and the hole have a lower energy than a case when the electron and the hole is not combined and separated away. Accordingly, the organic electroluminescent display (ELD) device utilizes the principle that light is emitted by an energy difference between before and after the combination of the electron and the hole.

FIG. 2 is a cross-sectional view of a related art active matrix organic electroluminescent display device.

As shown, the organic electroluminescent display (ELD) device has first and second substrate 10 and 50 spaced apart from each other. An array element layer 30 including a plurality of thin film transistors (T) formed in each sub-pixel is formed on the first substrate 10. A first electrode 32 electrically connected to the thin film transistor is formed on the array element layer 30 corresponding to each pixel. An organic light emitting layer 34 for displaying red (R), green (G) and blue (B) colors in each sub-pixel is formed on the first electrode 32 and a second electrode 38 is formed on the organic light emitting layer 34.

The organic light emitting layer 34 forms an organic electroluminescent diode element "E" together with the first and second electrodes 32 and 38.

The second substrate 50 that is used for an encapsulation has concave portion 52 and an absorbent desiccant 54 is filled into the concave portion 52. The moisture absorbent desiccant 54 removes moisture and oxygen that may be infiltrated into an interior of the organic electroluminescent display (ELD) device.

The organic electroluminescent display (ELD) device is completed by encapsulating edge portions of the first and second substrates 10 and 50 together using a seal pattern 70 between the first and second substrates 10 and 50.

As mentioned hereto, the related art bottom emission-type organic electroluminescent display (ELD) device is commonly manufactured by forming a thin film transistor array part and an organic light emitting part on a same substrate, and then bonding the substrate to an encapsulating structure. If the thin film transistor array part and the organic light emitting-part are formed on the same substrate, then a yield of a panel having the thin film transistor array part and the organic light emitting part is dependent upon the product of the individual yields of the thin film transistor array part and the organic light emitting part. However, the yield of the panel is greatly affected by the yield of the organic light emitting layer. Accordingly, if an inferior organic light emitting layer that is usually formed of a thin film having a thickness of 1000 Å has a defect due to impurities and contaminants, the panel is classified as a inferior panel.

This leads to wasted production costs and material, thereby decreasing the yield of the panel.

The bottom emission-type organic electroluminescent display (ELD) devices are advantageous for their high image stability and variable fabrication processing. However, the bottom emission-type organic electroluminescent display (ELD) devices are not adequate for implementation in devices that require high resolution due to limitations of increased aperture ratio.

In addition, since top emission-type organic electroluminescent display (ELD) devices emit light upward of the substrate, the light can be emitted without influencing the thin film transistor array part that is positioned under the light emitting layer. Accordingly, design of

the thin film transistor may be simplified. In addition, the aperture ratio can be increased, thereby increasing operational life span of the organic electroluminescent display (ELD) device. However, since a cathode is commonly formed over the organic light emitting layer in the top emission-type organic electroluminescent display (ELD) devices, material selection and light transmittance are limited such that light transmission efficiency is lowered. If a thin film-type passivation layer is formed to prevent a reduction of the light transmittance, the thin film passivation layer may fail to prevent infiltration of exterior air into the device.

#### [TECHNICAL SUBJECT OF INVENTION]

To solve the above problems, an object of the present invention is to provide an organic electroluminescent display device that has improved production yield, improved throughput, high resolution and high aperture ratio, and a method of manufacturing the organic electroluminescent display device.

For these purposes, an object of the present invention is to provide a dual panel type organic electroluminescent display (ELD) device where an array element and a diode on respective substrates are connected to each other using a plurality of electrical connecting patterns.

Another object of the present invention is to provide a plurality of electrical connecting patterns having a plastic deformation property to improve a contact property between an array element and an organic electroluminescent diode in a dual panel type organic electroluminescent display device.

#### [CONSTRUCTION AND OPERATION OF INVENTION]

To achieve these and other objects and in accordance with the purpose of the present invention, as embodied and broadly described, a dual panel type organic electroluminescent display device includes: first and second substrates having a plurality of sub-pixels defined thereon, the first and second substrates being spaced apart from and opposing each other; an array element layer on the first substrate, the array element layer having a plurality of thin film transistors each corresponding to each sub-pixel; a first electrode on an entire inner surface of the second substrate; an organic light emitting layer beneath the first electrode; a second electrode beneath the organic light emitting layer, the second electrode corresponding to each sub-pixel; an electrical connecting pattern between the array element layer and the second electrode and connecting the thin film transistor and the second electrode, the electrical connecting pattern including a material having a plastic deformation property and having a first height; and a seal pattern formed in an edge portion of the first and second substrates and attaching the first and second substrates, wherein a first height of the electrical connecting pattern is smaller than an original height of the electrical connecting pattern measured before an attachment of the first and second substrates.

The first height of the electrical connecting pattern is smaller than the original height of the electrical connecting pattern measured before the attachment of the first and second substrates by 5~20 %, and the material having a plastic deformation property is selected from conductive organic materials.

The device further comprises a protection electrode between the second electrode and the electrical connecting pattern, wherein the protection electrode has a pattern structure corresponding to the second electrode.

The electrical connecting pattern is electrically connected to the thin film transistor via an additional connecting electrode, and the electrical connecting pattern is connected to the



second electrode via a protection electrode and is connected to the thin film transistor via a connecting electrode.

The thin film transistor has a gate electrode, a source electrode and a drain electrode, and a connecting electrode contacts the drain electrode.

The electrical connecting pattern is formed on the array element layer.

In another aspect of the present invention, a method of manufacturing a dual panel type organic electroluminescent display device includes: forming an array element layer on a first substrate, the array element layer having a plurality of thin film transistors corresponding to a sub-pixel; forming an electrical connecting pattern having a first height on the array element layer, the electrical connecting pattern including a material having a plastic deformation property and connected to the thin film transistor; forming an organic electroluminescent diode on a second substrate, the organic electroluminescent diode having first and second electrodes and an organic light emitting layer between the first and second electrodes; forming a seal pattern in an edge portion of one of the first and second substrates; and attaching the first and second substrates using the seal pattern such that the array element layer is connected to the organic electroluminescent diode, wherein attaching the first and second substrates comprises reducing the first height of the electrical connecting pattern to a second height smaller than the first height by applying a plastic deformation force to the electrical connecting pattern.

A ratio of a difference between the first and second heights to the first height is within a range of 5~20 %, and the material having a plastic deformation property is selected from conductive organic materials.

Forming the electrical connecting pattern further comprises forming a connecting electrode connecting the thin film transistor and the electrical connecting pattern, and the

method further comprises forming a protection electrode having a pattern structure corresponding to the second electrode after forming the organic electroluminescent diode, wherein the second electrode and the electrical connecting pattern are connected to each other via the protection electrode.

Forming the array element layer further comprises forming a connecting electrode connecting the electrical connecting pattern and the thin film transistor, and forming the organic electroluminescent diode further comprises forming a protection electrode connecting the second electrode and the electrical connecting pattern.

Forming the array element layer further comprises forming the thin film transistor having a gate electrode, a source electrode and a drain electrode, wherein the connecting electrode contacts the drain electrode.

The thin film transistor is a driving thin film transistor.

Hereinafter, reference will now be made in detail to the preferred embodiment of the present invention, example of which is illustrated in the accompanying drawings.

#### -- FIRST EMBODIMENT --

This embodiment relates to a dual panel type organic electroluminescent display device where an array element and an organic electroluminescent diode on respective substrates are connected to each other using an electrical connecting pattern having a columnar structure.

FIG. 3 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a first embodiment of the present invention.

As shown, an organic electroluminescent display (ELD) device has first and second substrates 110 and 150 spaced apart from each other and opposing each other. A plurality of sub-pixels is defined on the first and second substrates 110 and 150.

An array element layer 140 having a plurality of thin film transistors “T” formed in each sub-pixel is formed on the first substrate 110. A connecting electrode 142 connected to the thin film transistor “T” is formed on the array element layer 140 and an electrical connecting pattern 144 contacting the connecting electrode 142 is formed on the connecting electrode 142.

The connecting electrode 142 and the electrical connecting pattern 144 may be formed to have a multi-layered structure including insulating material. The electrical connecting pattern 144 may be directly connected to the thin film transistor “T” omitting the connecting electrode 142.

The thin film transistor “T” has a semiconductor layer 112, a gate electrode 114 and source and drain electrodes 116 and 118 and the aforementioned connecting electrode 142 is electrically connected to the drain electrode 118.

A first electrode 150 is formed on an inner surface of the second substrate 150 and an organic light emitting layer 160 including main light emitting layers 156a, 156b and 156c respectively for red (R), green (G) and blue (B) colors is formed on the first electrode 152. A plurality of second electrodes 162 is formed on the organic light emitting layer 160 corresponding to each sub-pixel “P.”

More specifically, the organic light emitting layer 160 includes a first carrier transporting layer 154 contacting the first electrode and a second carrier transporting layer 158 contacting the second electrode 162 as well as the main light emitting layers 156a, 156b and 156c for the red (R), green (G) and blue (B) colors.

For example, when the first electrode 152 is the anode and the second electrode 162 is the cathode, the first carrier transporting layer 154 serves as a hole-inputting layer and a hole-transporting layer and the second carrier transporting layer 158 serves as an electron-transporting layer and an electron-inputting layer.

The first and second electrode 152 and 162 and the organic light emitting layer 160 interposed between the first and second electrodes 152 and 162 form an organic electroluminescent diode “E.”

In the present invention, current from the thin film transistor “T” is delivered to the second electrode 162 via the connecting electrode 142 and then the electrical connecting pattern 144.

The first and second substrates 110 and 150 are attached together by a seal pattern 170 between the first and second substrates 110 and 150.

Though not shown, at least one switching thin film transistor and at least one driving thin film transistor is formed for each sub-pixel and the thin film transistors “T” illustrated in FIG. 3 is the driving thin film transistor.

However, in the dual panel type organic electroluminescent display (ELD) device according the first embodiment of the present invention, if the driving thin film transistor “T” is not properly connected to the second electrode 162 by the electrical connecting pattern 144 for each sub-pixel, problems such as a point defect and irregular luminance distribution may occur.

To overcome the aforementioned problems, the electrical connecting pattern 144 may be of material having a plastic deformation property as in a second embodiment of the present invention that will be described hereinafter with reference to FIG. 4.

The dual panel type organic electroluminescent display (ELD) devices that will be described hereinafter in the present invention are the top emission-type organic electroluminescent display (ELD) device as in the first embodiment of the present invention.

-- SECOND EMBODIMENT --

FIG. 4 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to the second embodiment of the present invention. Explanations for elements of the dual panel type organic electroluminescent display (ELD) device having same structures as those of the first embodiment of the present invention will be omitted for the sake of explanation.

As shown, a first substrate 210 having an array element layer 240 formed thereon and a second substrate 250 having an organic electroluminescent diode "E" including first and second electrodes 252 and 262 and an organic light emitting layer 260 are spaced apart from each other and opposing each other. An electrical connecting pattern 244 is formed between the first and second substrates 210 and 250 to connect the array element layer 240 on the first substrate 210 with the organic electroluminescent diode "E."

The electrical connecting pattern 244 is formed of material having a plastic deformation property and formed for each sub-pixel. Though not shown, the electrical connecting pattern 244 may desirably be formed in a center portion of the sub-pixel.

As mentioned before, the dual panel type organic electroluminescent display (ELD) device according to the second embodiment of the present invention is the top emission type organic electroluminescent display (ELD) device in which the organic light emitting layer 260 emits light to the first electrode 252, i.e., an upper electrode 252. Accordingly, because the light is transmitted through a substrate having a superior endurance instead of a thin

passivation layer unlike the related art, a credibility of the product can be increased. In addition, because the organic electroluminescent diode “E” is formed on a separate substrate from the array element layer, an aperture ratio can be increased regardless of a structure of the thin film transistor “T.”

Once the electrical connecting pattern 244 is attached to the array element layer 240 and the second electrode 262, the electrical connecting pattern 244 is compressed and a height “I” of the electrically connecting pattern 244 is reduced by the compression because the electrical connecting pattern 244 is formed of the material having the plastic deformation property. A contact property between the array element layer 240 and the organic electroluminescent diode “E” can be improved by implementing the electrical connecting pattern 244 having the plastic deformation property.

The electrical connecting pattern 244 having the plastic deformation property is desirably formed of conductive organic material.

FIGs. 5A and 5B are cross-sectional views of the electrical connecting pattern to explain a plastic deformation property that is required for the second embodiment of the present invention. FIG. 5A and FIG. 5B are respectively for the electrical connecting patterns having a triangular cross section and a rectangular cross section.

In FIG. 5A, an original height of the electrical connecting pattern 246 before an attachment to the array element layer 240 and the organic electroluminescent diode “E” is defined as a first height “IIa,” a height of the electrical connecting pattern 246 after the attachment is defined as a second height “IIb” and a difference between the first height “IIa” and the second height “IIb” is defined as a third height “IIc.” The first and third heights “IIa” and “IIc” satisfy the following expression.

$$(IIC / IIA) \times 100 = 5 \sim 20 \%$$

The same principle can be applied to the electrical connecting pattern 248 having a rectangular cross section as in FIG. 5B. An original height of the electrical connecting pattern 248 before an attachment to the array element layer 240 and the organic electroluminescent diode "E" is defined as a fourth height "IIIa," and a height of the electrical connecting pattern 248 after the attachment is defined as a fifth height "IIIb." Further, a difference of the fourth height "IIIa" and the "IIIb" is defined as a sixth height "IIIc." Then, the fourth height "IIIa" and the sixth height "IIIc" satisfy the following expression.

$$(IIIc / IIIa) \times 100 = 5 \sim 20 \%$$

As mentioned above, a plastic deformation range of the electrical connecting pattern is between 5 % and 20 % according to the present invention. The flatness of a glass substrate that is usually used for a base substrate of the organic electroluminescent display (ELD) device is generally above 5 %. Accordingly, if the electrical connecting pattern has the plastic deformation range under 5 %, the electrical connecting pattern cannot contact the array element layer and the organic electroluminescent diode enough to deliver an electrical signal from the thin film transistor to the second electrode. On the other hand, if the electrical connecting pattern has a plastic deformation range above 20 %, an excessive plastic deformation force of the electrical connecting pattern may cause a break of an array element of the organic electroluminescent display (ELD) device and thus may cause an malfunction of the organic electroluminescent display (ELD) device.

The aforementioned plastic deformation range that is required for the electrical connecting pattern of FIGs. 5A and 5B can be applied to the embodiments that will be described hereinafter.

-- THIRD EMBODIMENT --

A third embodiment relates to a dual panel type organic electroluminescent display device where an additional protection electrode is disposed between an electrical connecting pattern of a material having a plastic deformation property and a second electrode of an organic electroluminescent diode and protects a second electrode from a deformation force.

FIG. 6 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a third embodiment of the present invention.

As shown, an organic electroluminescent display (ELD) device according to the third embodiment of the present invention has a first substrate 310 having an array element layer 340 formed thereon and a second substrate 350 having an organic electroluminescent diode "E" formed thereon, and an electrical connecting pattern 344 is formed between the first and second substrate 310 and 350. The electrical connecting pattern 344 is formed of material having a plastic deformation property and electrically connects the array element layer 340 with the organic electroluminescent diode "E." An additional protection electrode 364 is further formed on a second electrode 362 corresponding to each sub-pixel. Accordingly, the electrical connecting pattern 344 is electrically connected to a drain electrode 318 and the second electrode 362.

The protection electrode 364 is disposed between the second electrode 362 and the electrical connecting pattern 344 and has a pattern structure corresponding to the second electrode 362. The protection electrode 364 functions as a kind of buffer electrode to protect the second electrode 362 from being damaged by a plastic deformation force of the electrical connecting pattern 344. The electrical connecting pattern 344 has a height "IV" that is a reduced height to an amount of 5 ~ 20 % of an original height by the plastic deformation force of the electrical connecting pattern 344. Accordingly, the plastic deformation force of the electrical connecting pattern 344 improves contact properties between the electrical



connecting pattern 344 and the array element layer 340 and between the electrical connecting pattern 344 and the organic electroluminescent diode “E.”

The electrical connecting pattern 344 of the third embodiment of the present invention can be formed of conductive organic material as in the second embodiment of the present invention.

#### -- FOURTH EMBODIMENT --

A fourth embodiment relates to a dual panel type organic electroluminescent display device where an electrical connecting pattern of a material having a plastic deformation property is connected to a protection electrode and an additional connecting electrode.

FIG. 7 is a cross-sectional view of a dual panel type organic electroluminescent display (ELD) device according to a fourth embodiment of the present invention.

As shown, an organic electroluminescent display (ELD) device according to the fourth embodiment of the present invention has a first substrate 410 having an array element layer 440 and a second substrate 450 opposing the first substrate 410 and having an organic electroluminescent diode “E,” and electrical connecting pattern 444 between the first and second substrates 410 and 450. The electrical connecting pattern 444 is formed of material having a plastic deformation property and is electrically connected to the array element layer 440 and the organic electroluminescent diode “E.” The connecting electrode 442 is electrically connected to a drain electrode 418, and the electrical connecting pattern 444 connects the protection electrode 464 and the connecting electrode 442 electrically.

The electrical connecting pattern 444 has a height “V” that is a reduced height to an amount of 5 ~ 20 % of an original height by the plastic deformation force of the electrical connecting pattern 444. Accordingly, the plastic deformation force of the electrical

connecting pattern 444 improves contact properties between the electrical connecting pattern 444 and the array element layer 440 and between the electrical connecting pattern 444 and the organic electroluminescent diode “E.”

The electrical connecting pattern 444 can be formed of conductive organic material.

The connecting electrode 442 is electrically connected to the drain electrode 418 of the thin film transistor “T” and serves to protect the drain electrode 418 from an attachment force between the first and second substrates 410 and 450 and a plastic deformation force of the electrical connecting electrode 444. If the electrical connecting pattern 444 is electrically connected to the drain electrode 418 via a drain contact hole 420 formed through a passivation layer 422 without the additional connecting electrode 442, a contact property is poor owing to a small contact area between the electrical connecting pattern 444 and the drain electrode 418. However, because the electrical connecting pattern 444 is electrically connected to the drain electrode 418 through the intermediate connecting electrode 442, the contact property can be greatly improved by enlarging a contact area between the electrical connecting pattern 444 and the drain electrode 418.

#### -- FIFTH EMBODIMENT --

FIG. 8 is a flow chart illustrating a fabrication sequence of a dual panel type organic electroluminescent display (ELD) device according to a fifth embodiment of the present invention. In one aspect of the present invention, the fabrication sequence for the dual panel type organic electroluminescent display (ELD) device having an electrical connecting pattern having a plastic deformation property, a connecting electrode and a protection electrode is taken as an example.

In a first step (ST1), an array element layer is formed on a first substrate and an organic electroluminescent diode is formed on a second substrate. A process for forming the array element layer on the first substrate comprises steps of forming a thin film transistor having a gate electrode, a source electrode and a drain electrode, forming a passivation layer having a drain contact hole to expose a portion of the drain electrode, forming a connecting electrode connected to the drain electrode via the drain contact hole and forming an electrical connecting pattern on the connecting electrode.

The connecting electrode and the electrical connecting pattern are formed one of conductive materials.

Specifically, the electrical connecting pattern is formed of material having a plastic deformation property and desirably formed of material having a plastic deformation range of 5~20 %. Accordingly, the electrical connecting pattern may be formed of conductive organic material.

A process for forming the organic electroluminescent diode on the second substrate having a plurality of sub-pixels defined thereon comprises steps of forming a first electrode on the second substrate, forming an organic light emitting layer having light emitting layers for red (R), green (G) and blue (B) colors, forming a second electrode on the organic light emitting layer corresponding to each sub-pixel and forming a protection electrode on the second electrode. The protection electrode has a pattern structure corresponding to the second electrode.

The first and second electrodes and the organic light emitting layer form the organic electroluminescent diode.

The organic light emitting layer and the second electrode may be formed separately for each sub-pixel by a shadow mask method or a partition using method. That is, the organic

light emitting layer and the second electrode may be formed in each sub-pixel by sequentially patterning the organic light emitting layer and the second electrode according to the shadow mask method or may be separately formed in each sub-pixel automatically without additional patterning process by forming a plurality partitions in boundaries of each sub-pixel.

The protection electrode may be formed of conductive material and may desirably be formed thick to play a role of a buffer. The first step ST1 for forming the first and second substrates includes a seal patterning forming process. That is, the seal pattern is formed on one of the first and second substrates to attach the first and second substrates.

In a second step (ST2), the first and second substrates are attached together by the seal pattern and this step includes a step for applying a plastic deformation force to the electrical connecting pattern to electrically connect the array element layer on the first substrate and the organic electroluminescent diode on the second substrate.

Once the electrical connecting pattern receives the plastic deformation force, the electrical connecting pattern having a first height is compressed to have a second height smaller than the first height.

The electrical connecting pattern of the present invention desirably has a plastic deformation range, i.e., ratio of a third height that is difference between the first and second heights to the first height of 5~20 %. With the existence of the electrical connecting pattern having the plastic deformation property, a contact property between the array element layer and the organic electroluminescent diode may be improved.

It will be apparent to those skilled in the art that various modifications and variations can be made in the fabrication and application of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the

modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

For example, even though an organic electroluminescent display device that includes two pixels each having red, green and blue sub-pixels is illustrated for drawings of the first to fourth embodiments, a plurality of pixels are formed in an organic electroluminescent display device according to another embodiment.

#### [EFFECT OF INVENTION]

As mentioned hereto, the dual panel type organic electroluminescent display (ELD) device having the electrical connecting pattern having the plastic deformation property has advantages as followings.

First, because the array element layer and the organic electroluminescent diode are formed respectively on different substrates, a production yield can be increased and a life cycle of products can be extended.

Secondly, because the dual panel type organic electroluminescent display (ELD) device according to the present invention is the top emission-type, the thin film transistor can be designed with facility and a high aperture ratio and a high resolution can be achieved.

Thirdly, because the array element layer on the first substrate and the organic electroluminescent diode is electrically connected by the electrical connecting pattern having the plastic deformation property, a contact property between the array element layer and the organic electroluminescent diode can be improved by the plastic deformation force of the electrical connecting pattern.